Setting Agricultural Research Priorities in Sub-Saharan Africa

Criteria, Issues, and Options

Osita M. Ogbu

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ABSTRACT

Given declining agricultural productivity, scarce research resources, and the need for research on almost all crops grown in sub-Saharan Africa (SSA), this paper discusses and explores additional criteria for identifying agricultural research priorities in the sub-region. Using data on crops from both the Sahel and SADCC regions, the paper identifies the issues and trade-offs, and underscores the need for the search for a methodology reconciling the various criteria in order to minimize conflicting objectives and trade-offs arising from decisions on resource allocation. Depending on the national goals, the identification of research priorities will require both equity and efficiency considerations. But quick production responses, irrespective of the equity implications, may become necessary in order to break the current pessimistic mood and restore hope. The paper recommends a coordinated effort between donors, international development agencies, and national research systems on a well-defined, clearly prioritized, and demand-driven research agenda.

CONTENTS

I. INTRODUCTION

Agriculture is the leading sector in sub-Saharan Africa (SSA) and supports most of the population. Growth in agriculture has not kept pace with growth in population and declining ability to import has heightened food security concerns. Where growth in agriculture has occurred, it has been mainly due to extensification of agriculture (Lele and Stone, 1989). With increased population pressure, environmental concerns, and declining land availability, there is an urgent need to move from traditional land extensification farming systems to technological based land intensification methods. Although technological change is central to the process of growth, there is considerable uncertainty about which agricultural commodity or group of commodities offer the most promise for future growth and development. This is especially so given the gloomy international trade prospects, on-going improvements in domestic macro economic environment, the diverse social and agro-ecological conditions under which crops are produced, the risky nature of agricultural activity in SSA, pockets of population densities, the economic circumstances of the crop(s), cultural values and social institutions in SSA.

A great deal of resources have been devoted to agricultural research in sub-Saharan Africa (a mean of about 1.3% of agricultural GDP in six MADIA (Managing Agricultural Development in Africa) countries (Kenya, Malawi, Nigeria, Senegal, and Tanzania) and 0.9% for SSA as a whole; see Lele, Kinsey and Obeya, 1989). Full time agricultural research scientists in SSA increased from an average of 1,323 in the early 60s to 4,941 in the early 80s. Real expenditure per researcher which averaged 113,000 dollars in the early 60s declined to 75,000 dollars in the early 80s. Despite this decline, the per capita researcher expenditure in SSA is still higher than for other less developed regions except Latin America and Caribbean (see Pardey and Roseboom, 1990).

In spite of this level of resources, post-independence agricultural research programs in SSA have lacked focus and are, often, neither integrated into the overall agricultural strategy of the countries nor do they fit into the national macro and social goals. Research priorities have been dictated by import substitution strategy, narrow individual scientist's concerns, donor bias, political importance of individual crop and the dichotomy between export and food crops. For instance, Carr (1989) notes that although cowpeas is the most important legume crop grown in SSA in terms of area under cultivation, very little research has been done on the crop with the result that only limited technology is currently available for its improvement. Yet, this is a crop that fits into the mixed cropping pattern of most of SSA. Eicher (1990) notes that unlike the

colonial period when research was focused successfully on a single crop such as cotton, groundnuts, cocoa etc., many National Agricultural Research Systems (NARS) and donors are promoting diffuse research efforts. Thus, ignoring the experience of the past and spreading research resources over a large number of commodities with very limited results. The MADIA study has identified the key factors that influence the success or failure of research systems in SSA (Jammeh, Gbetibouo and Lele, 1990).

Given the poor performance of agriculture across the board, and the need for research on almost all the crops grown in SSA, there is the pressure to spread thin the limited research resources across many crops and on farm systems research.[1] Unfortunately, this approach accomplishes very little since not enough resources are devoted to any one crop or activity as to achieve tangible results. The alternative approach is to select a few priority crops that have sustained economic and social benefits and concentrate the resources on them.

This paper identifies a set of criteria that can be used to set agricultural research priorities in sub-Saharan Africa. Using data for both the SAHEL and SADCC regions, the paper underscores the need to balance these criteria in order to minimize conflicting objectives and trade-offs. **The discussions are limited, in most part, to crops.**

[1] The discussions in this paper are limited to crops but in deciding research priorities for the region, attention must be paid to forestry, agro-forestry, natural resource management issues and their interaction with crops. For instance a crop may be on the research agenda if, in addition to other factors, it is complimentary to tree farming.

II. CRITERIA

A lot has been written on African agricultural research problems (for instance, Horton, 1986; Binswanger, 1986; Eicher, 1990; Jammeh, Gbetibouo and Lele, 1990) but none has focused specifically on the criteria and issues involved in setting research priorities in sub-Saharan Africa. Horton (1986) and Binswanger (1986) focused on the impact of agricultural research systems on agricultural development while Eicher (1990) and Jammeh et. al. (1990) focused on building agricultural research capacity. Eicher (1990) suggested that research on methodology for agricultural priority setting should be on the research agenda of agricultural economists. This paper is partly in response to this identified need.

Table 1 summarizes the criteria that can be employed to set national research agenda in SSA. The economic and environmental importance of the crop(s) are balanced with equity considerations, possibility of scientific break through, donor efforts and the existence of critical mass of scientists working on the crop(s). The actual weight assigned to each of these criterion will depend on the national macro and social goals. But four standard methods for setting priorities are often cited in the literature. These are: (a) weighted criteria models, (b) benefit-cost, expected economic surplus analysis, (c) mathematical programming and (d) simulation (see Norton and Pardey, 1987). With varying degrees of success each of the above methodologies can be applied to the criteria and the indicators listed on Table 1. These methodologies provide insights as to the "optimal" combinations of the criteria and thus, the weights that could be assigned to each of them. The application of these methodologies is not the subject of this paper. **This is a discussion paper whose main aim is to explore additional criteria and stimulate the search for a methodology for reconciling the various criteria for allocating agricultural research resources in the context of sub-Saharan Africa region.**

The identification of research priorities in SSA by any set of criteria or methodologies involves important trade-offs and, sometimes, conflicting objectives given the economic, social and technical realities. Whether the focus should be on crops with high value added or crops that are widely grown, food or export crops, potentially high yielding or low yielding but widely consumed crops, crops that economize on modern inputs such as fertilizer and pesticides or farm systems management, or crop specific research or whether the criteria should be equity or efficiency, there are critical issues that need to be understood and important trade-offs that need to be addressed.

This paper attempts to identify these issues and trade-offs for the SAHEL and SADCC regions. Data required for an exercise such as this are not always available. Thus the criteria chosen were dictated soley by data availability. Even then, Food and Agricultural Organization (FAO) data used for this paper should not be regarded as definitive but they provide important guidance in the discussion of research priority issues. For simplicity, the analyses have been grouped under export and food crops.

Table 1. Criteria and methodology for setting agricutural research priorities in sub-Saharan Africa.

Criteria	Indicators and Methodology
1. Economic importance of crops(s)	a. Contribution to agricultural GDP (value) b. Contribution to GDP (value) c. Proportion of land under cultivation by a crop or crops d. Growth rates in (i) internal demand (consumption) (ii) exports (iii) imports Share of crop or livestock in agricultural imports and exports
2. World market outlook	a. Projections of world demand (GDP growth trends of consuming countries) b. Production volume by major producers by country and region
3. Possibility of scientific breakthrough	Review of current research on strategic crops
4. Environmental sustainability	The effects of crop(s) in maintaining or improving soil fertility, soil moisture, complimentarity to tree farming, economy of modern inputs such as fertilizer and pesticides etc.
5. Equity: employment & income	a. Proportion of farmers' income that come distribution effects from a given crop b. Number of farmers or households engaged in producing the said crop c. Type of farmers: estates/commercial, smallholders, or subsistence d. Regional cropping patterns
6. Research capacity	a. Number of agric. research institutes b. University departments conducting research on particular crop(s) or systems c. Number of scientists (or some close indicator) conducting research on crop(s) d. Public expenditure on agricultural research e. Adaptive on-farm research results
7. Low/high potential areas	Yield potential (growth of yield/acre) (arid vs irrigated land)
8. Market factors	Taste preferences, shelf life, transport requirements, etc.

III. THE SAHELIAN REGION

Post independence research efforts were concentrated on export crops as part of the colonial legacy. But unlike the colonial times, the priority placed on export crops did not always fit into the grand strategy for the overall agricultural development of the individual countries. Most of the adaptive research failed because it did not recognize the local needs of the farmers. Moreover, research done for the temperate zones could not be adapted easily to the tropics. These research efforts were, therefore, not demand driven (Jammeh, Gbetibouo, and Lele (1990)). Severe food shortages have led to a shift of substantial resources to food crops especially irrigated rice.

Export Crops

The most important export crops in the Sahelian region are cotton and groundnut (see Fig. 1 for a sub-regional picture and the tables for individual country situations). Cotton accounted for 80 % of total value of agricultural exports in Burkina Faso, 40% in Chad, 55% in Mali and 4.1% in Senegal in 1988. Except for Niger and Mali where growth in cotton yield was 0.3% and 3% respectively, and Senegal where it was 11% in the 80s, cotton yield grew at an annual average of 6% for the rest of the countries in the region. Groundnut export is dominant in Gambia and Senegal accounting for 42% and 19%, respectively, of total value of agricultural export. It also accounts for 48% of total harvested area in Gambia, 40% in Senegal and 5% for the rest of the countries (Tables 2, 3, and 4).

Do these impressive figures justify spending research resources on any or all of these crops even in the face of gloomy world prices and the urgent need to increase food output? Intensification of production of cash crops or improving their yields could play an important role of releasing labor for other activities (including off-farm employment) especially for smallholders for whom labor costs constitute a major input cost (Lele, Kinsey and Obeya, 1989) and for subsistence farmers for whom off-farm employment constitute a major source of income. It could do this by greatly alleviating labor constraints imposed by seeding, weeding and land preparation. But if labor shortages (a contentious issue in itself) becomes the focus for technological development, the likely future labor supplies are more important for research planning than the current labor situation, especially given the high population growth rates and the lag between investment in research and production of technologies that farmers can use profitably.

Cotton is an important export crop in the Sahel and can grow virtually every where. Given the ecological constraints of the Sahel region, investment in cotton research may be worthwhile. However, it is important to recognize whether the possibility for a breakthrough exists, and if not to compare the expected incremental knowledge from research to the marginal cost.

Table 2. Commodity/ Livestock Shares in Total Agricultural Export in Sahelian countries (%).

A.	Burkina Faso				
	Crops/Livestock	1983	1985	1987	1988
	Fruits & Vegetables	4.1	4.1	2.1	1.6
	Hides & Skins	1.2	7.5	5.0	4.3
	Cotton	59.1	61.7	76.3	79.8
	Oil seed	15.8	16.0	5.5	3.5
	Live animal	9.5	15.4	9.5	9.2
B.	Chad				
	Crops/Livestock	1983	1985	1987	1988
	Cotton	8.5	25.8	32.5	40.0
	Live animal	90.3	73.7	67.5	58.9
C.	Gambia				
	Crops/Livestock	1983	1985	1987	1988
	Groundnut	74.7	54.3	42.7	41.8
	Animal vegetable oil	20.5	34.3	47.1	46.8
	Fish & fishery products	5.0	10.5	12.6	11.2
D.	Mali				
	Crops/Livestock	1983	1985	1987	1988
	Fruits & vegetables	1.4	2.7	1.9	1.9
	Groundnut	1.9	1.5	1.6	1.2
	Cotton	18.4	44.8	54.3	54.8
	Live animal	71.5	45.3	38.1	38.3
E.	Senegal				
	Crops/Livestock	1983	1985	1987	1988
	Fruits & vegetables	0.7	1.0	1.4	1.5
	Cotton	6.6	6.2	1.9	4.1
	Groundnut	30.7	17.8	14.7	18.6
	Fish & fishery products	42.4	68.0	75.8	64.0

Source: Computed from FAO Trade Year Book (1984 and 1988).

Table 3. Annual Average Growth Rates in Crop Yields in the Sahel (%).

A.	Burkina Faso	1981-85	1986-89	1981-89
	RICE-PADDY	12.0	1.1	7.1
	MAIZE	5.6	5.6	5.6
	MILLET	5.0	-0.01	2.8
	SORGHUM	5.7	1.5	3.8
	CASSAVA	4.3	-7.8	-1.1
	YAMS	0.1	5.7	2.6
	SUGAR-CANE	0.4	0.1	-0.2
	PEAS-COWDRY	0.1	0.8	0.4
	GROUNDNUT (IN SHELL)	5.5	3.4	4.6
	COTTON	8.2	5.0	6.7
B.	Cape Verde	1981-85	1986-89	1981-89
	MAIZE	-5.0	5.5	-0.3
	POTATOES	15.1	3.4	9.9
	CASSAVA	26.6	1.6	15.5
	SUGARCANE	1.6	0.3	1.0
	GROUNDNUT (IN SHELL)	NA	5.0	NA
C.	Chad	1981-85	1986-89	1981-89
	WHEAT	8.3	-2.2	3.6
	RICE-PADDY	108.7	61.1	87.5
	MAIZE	-2.1	0.9	-0.7
	MILLET	19.5	2.1	11.7
	SORGHUM	4.3	2.5	3.5
	POTATOES	1.5	3.9	2.6
	CASSAVA	2.7	1.5	2.1
	YAMS	2.1	1.3	1.7
	SUGAR-CANE	-1.0	-0.1	-0.6
	GROUNDNUT (IN SHELL)	3.0	4.1	3.5
	MELON-SEED	0.1	0.0	0.0
	COTTON	7.7	2.7	5.5
D.	Gambia	1981-85	1986-89	1981-89
	RICE-PADDY	4.4	-5.2	0.1
	MAIZE	11.9	1.8	7.4
	MILLET	4.5	-0.3	2.4
	SORGHUM	4.6	3.7	4.2
	CASSAVA	0.0	0.0	0.0
	GROUNDNUT (IN SHELL)	11.4	0.9	6.7
	OIL PALM FRUIT	1.7	0.0	1.0
	COTTON	4.0	7.6	5.6

(continued)

Table 3. Continued

E.	Mali	1981-85	1986-89	1981-89
	WHEAT	7.3	-5.2	1.8
	RICE-PADDY	17.3	0.0	9.6
	MAIZE	17.9	3.8	11.6
	MILLET	3.2	6.8	4.8
	SORGHUM	7.4	10.3	8.7
	CASSAVA	1.3	0.0	0.7
	YAMS	-4.2	0.3	-2.2
	SUGAR-CANE	1.6	-0.6	0.6
	GROUNDNUT (IN SHELL)	6.7	4.8	5.8
	TEA	1.3	0.0	0.7
	COTTON	2.6	3.8	3.1

F.	Mauritania	1981-85	1986-89	1981-89
	WHEAT	15.0	1.3	8.9
	RICE-PADDY	-0.2	0.7	0.2
	BARLEY	7.6	1.4	4.9
	MAIZE	12.0	-5.5	4.2
	MILLET	199.4	20.2	119.8
	SORGHUM	8.9	13.4	10.9
	POTATOES	-6.5	-0.7	-3.9
	YAMS	1.0	1.8	1.3
	PEAS-COWDRY	2.2	2.8	2.5
	GROUNDNUT (IN SHELL)	7.8	3.7	6.0

G.	Niger	1981-85	1986-89	1981-89
	WHEAT	17.2	3.5	11.1
	RICE-PADDY	13.1	-7.4	4.0
	MAIZE	-5.5	25.3	8.2
	MILLET	6.9	-3.0	2.5
	SORGHUM	-6.4	6.0	-0.9
	POTATOES	-5.3	-2.2	-3.9
	CASSAVA	2.7	-1.9	0.6
	SUGAR-CANE	-6.4	0.2	-3.5
	PEAS-COWDRY	-13.5	14.8	-0.9
	GROUNDNUT (IN SHELL)	6.0	23.0	13.5
	COTTON	1.1	-0.7	0.3

(continued)

Table 3. Concluded.

H.	Senegal	1981-85	1986-89	1981-89
	RICE-PADDY	17.5	1.9	10.6
	MAIZE	19.2	-2.3	9.6
	MILLET	10.8	5.7	8.5
	SORGHUM	4.0	3.6	3.8
	POTATOES	3.6	1.7	2.8
	CASSAVA	5.7	-11.3	-1.9
	SUGAR-CANE	-2.1	0.9	-0.8
	PEAS-COWDRY	14.0	-10.7	3.1
	GROUNDNUT (IN SHELL)	23.8	1.3	13.8
	OILPALM FRUIT	0.0	0.0	0.0
	MELON-SEED	2.6	0.0	1.4
	COTTON	7.9	14.2	10.7

Source: Computed from FAO data in the World Bank Data Base.

Table 4. Share of Harvested Area in the Sahel (%).

A.	Burkina Faso	1980	1985	1988
	RICE-PADDY	1.6	1.0	0.6
	MAIZE	5.0	5.1	7.7
	MILLET	30.8	34.5	35.3
	SORGHUM	41.0	38.2	35.8
	CASSAVA	0.1	0.1	0.1
	YAMS	0.3	0.4	0.1
	SUGAR-CANE	0.2	0.1	0.1
	PEAS-COWDRY	13.3	11.0	8.9
	GROUNDNUT (IN SHELL)	4.5	6.4	6.7
	SEED COTTON	3.2	3.4	4.7
B.	Cape Verde	1980	1985	1988
	MAIZE	77.2	49.6	85.9
	POTATOES	0.6	4.5	0.7
	CASSAVA	5.1	3.8	1.4
	SUGAR-CANE	15.4	37.6	10.3
	GROUNDNUT (IN SHELL)	1.5	4.5	1.7

(continued)

Table 4. Continued.

C.	Chad	1980	1985	1988
	WHEAT	0.2	0.3	0.3
	RICE-PADDY	2.8	1.5	1.5
	MAIZE	2.1	3.8	4.1
	MILLET	29.7	31.6	30.2
	SORGHUM	34.2	35.1	34.8
	POTATOES	0.2	0.2	0.2
	CASSAVA	3.8	4.7	4.7
	YAMS	1.4	1.6	1.6
	SUGAR-CANE	0.2	0.2	0.2
	GROUNDNUT (IN SHELL)	11.9	8.8	7.5
	MELON-SEED	1.9	2.0	1.8
	COTTON	11.6	10.3	13.1

D.	Gambia	1980	1985	1988
	RICE-PADDY	15.9	7.5	9.8
	MAIZE	4.3	10.6	4.9
	MILLET	19.3	31.1	29.5
	SORGHUM	4.1	8.1	4.9
	CASSAVA	1.5	1.2	1.0
	GROUNDNUT	50.5	36.4	47.6
	OILPALM	2.8	2.2	1.7
	COTTON	1.7	2.9	0.6

E.	Mali	1980	1985	1988
	WHEAT	0.1	0.1	0.1
	RICE-PADDY	8.5	8.2	9.7
	MAIZE	2.6	6.1	5.2
	MILLET	41.5	48.2	45.4
	SORGHUM	28.0	26.3	28.3
	CASSAVA	0.4	0.4	0.4
	YAMS	0.1	0.1	0.1
	SUGAR-CANE	0.3	0.1	0.2
	GROUNDNUT (IN SHELL)	10.2	3.1	4.1
	TEA	0.0	0.0	0.0
	COTTON	8.3	7.3	6.5

(continued)

Table 4. Concluded.

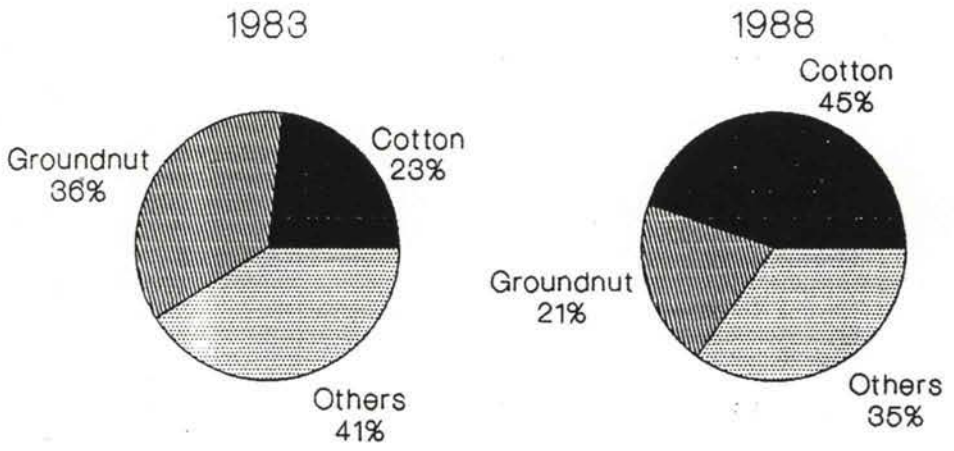
F.	Niger	1980	1985	1988
	WHEAT	0.02	0.06	0.05
	RICE-PADDY	0.4	0.4	0.4
	MAIZE	0.3	0.1	0.1
	MILLET	59.1	57.7	48.9
	SORGHUM	14.8	20.8	20.7
	POTATOES	0.0	0.0	0.0
	CASSAVA	0.4	0.4	0.4
	SUGAR-CANE	0.1	0.1	0.1
	PEAS-COWDRY	21.2	18.2	27.5
	GROUNDNUT	3.6	2.2	1.8
	COTTON	0.1	0.1	0.1
G.	Senegal	1980	1985	1988
	RICE-PADDY	2.8	3.4	3.6
	MAIZE	3.2	4.4	5.0
	MILLET	39.5	49.6	39.8
	SORGHUM	5.5	8.2	5.8
	POTATOES	0.0	0.0	0.0
	CASSAVA	0.3	0.3	0.2
	SUGAR-CANE	0.2	0.3	0.3
	PEAS-COWDRY	2.1	5.2	3.1
	GROUNDNUT (IN SHELL)	44.6	26.2	39.9
	OILPALM-FRUIT	0.3	0.3	0.3
	MELON-SEED	0.2	0.3	0.3
	COTTON	1.2	1.7	1.6

Source: Computed From FAO Data in the World Bank Data Base.

The International Research on Cotton and Textile (IRCT) center has been able to provide a regional approach to cotton research in the Sahel that transcends national boundaries but this regional role is disappearing fast as national systems develop. Unfortunately, this may impact adversely on research on, and productivity of, cotton for this region unless a CGIAR-type (Consultative Group on International Agricultural Research) research organization with strong linkages to producing households emerges.

Groundnut is both an export crop as well as a major food crop. Export of groundnut in the Sahel has a higher potential for generating higher income and employment than food crops, and the impact of increased export on the overall economy is much greater because of the macro implications of foreign exchange availability. Thus, the return on research investment

Figure 1. Share of total agricultural export in the Sahel by major crops in 1983 and 1988.



Source: Data from FAO Trade Year Books

on export crops appears greater than that for food crops. There are additional factors that make groundnut a candidate in the priority list. Current groundnut variety is about 20 years old and yields are growing much more slowly. In the two major groundnut producing countries of the Sahel, Gambia and Senegal, yield grew, annually, in the late 80s by 1%. Yet in the early 80s, it was growing by 11% in Gambia and by 24% in Senegal (see Table 3). But declining yield may be due to declining fertilizer use, effects of disease and pests, or lack of crop husbandry due to increasing cost of labor. Despite all these, improvement in groundnut yields should be part of the research agenda and understanding the source or sources of yield decline will provide important guidance in developing appropriate technology.

Devoting scarce research resources to cash crops assumes that the growth prospects are greater through the export front. However, given the gloomy price prospects, the agricultural practices of the industrialized west (the combined effects of protectionist import policies and export subsidies) and food security concerns, an undue emphasis on export crops' research may be unwarranted. Yet, debt service obligations and the need for foreign exchange make increased research on export crops an attractive proposition. Even when there is an agreement on increased research on export crops, there may not be an agreement on the target recipient of the results. For a "Big Bang" effect, it will be necessary to develop technology appropriate for the commercial farmers. But equity considerations and long term sustainable growth concerns will dictate that research resources should be used to develop technology appropriate for the small farmers. This is not to suggest that, for instance, high yielding variety of seeds cannot be used

by small farmers. Experience from SSA indicates that the adoption of high yielding variety by small farmers depend on complimentary factors such as availability of credit, extension and training, access to inputs like pesticides (including input subsidy), fertlizers or irrigation water.

There is also the very important question of research on livestock. In the Sahel, livestock export is a very important source of foreign exchange. For Chad and Mali it is the most important agricultural export. Exports of livestock was 59% of total agricultural exports from Chad in 1988 having declined from 90% in 1983. In Mali it was 38% in 1988 having declined from 72% in 1983. The declining share in both cases was as a result of improved export of cotton.

There are other concerns as well. There are research concerns on the sustainability of production. Thus, even when there is a need for improved variety, it may indeed be optimal to spend scarce research resources on soil management, in reducing soil acidity or improving soil-nutrient-retention ability. In Senegal, for instance, the problem of acid soil and soil with poor ability to hold nutrients are serious in the regions with high output potential. Moreover, some higher yielding varieties may require more water which is a major constraint in the Sahel (World Bank, 1987).

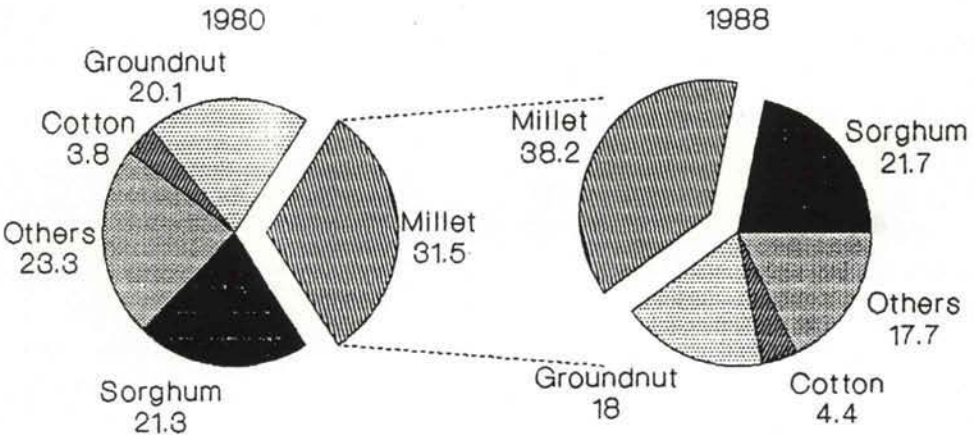
The argument here is that the focus of agricultural research should be on farm systems while the market should determine crop priorities. In other words, yield maximization should not be the only factor that determines research focus. Market factors such as taste preferences, shelf life, transport requirements etc. should be given serious consideration in determining research priorities. Analysis of transportation costs, for instance, will determine for each region, the extent to which production will have to be subsistence or commercial in nature thus assisting in appropriately directing agricultural research.

Food Crops

Food security concerns engendered, in part, by declining ability to import have prompted a shift in the focus of agricultural research from export crops to food crops. Tied to this is the concern for malnutrition which is a major cause of death for children under five in many countries of sub-Saharan Africa. Thus, from the onset, this presents an important trade-off. Should research be focused on crops that can be grown virtually every where with high yields but, perhaps, low in nutritious content such as millet and sorghum or on low yielding but highly nutritious crops such as cowpea? Put differently, should the priority for research be placed on crops with negative income elasticity of demand such as millet and sorghum or on crops with high income elasticity of demand such as rice and wheat? These elasticities are, often, indicators of nutritional contents and taste preferences.

Millet and sorghum, by several measures are important food crops in the Sahel (see Fig. 2 for their share of harvested area in the sub-region). Millet accounts for about 30% of all harvested area in Burkina Faso, Chad and Gambia in the late 80s, and for 46% in Mali, 50% in Niger, and 40% in Senegal. Except for the major groundnut producing countries (Gambia and Senegal), sorghum accounts for between 21% to 36% of all harvested area in the rest of the Sahelian countries in the late 80s (see Table 4). Their combined share in total volume of agricultural crops produced is about 55% except in Senegal, Gambia and Cape Verde. These

Figure 2. Share of harvested area in the Sahel by major crops in 1980 and 1988 (%).



Source: FAO Data from the World Bank

crops are produced by a wide variety of farmers and are the main staples in the rural areas. They therefore meet important equity criteria.

As can be discerned from Table 3, growth in yields in the late 80s has not been impressive when compared to the early 80s. Yields in millet, in the late 80s, were not growing in Burkina Faso, were growing annually by 2.1% in Chad, -0.3% in Gambia, -3.0 in Niger, 5.7 in Senegal, and 20.2 in Mauritania. Again, these figures should be interpreted with caution. Except in Mauritania and Senegal, sorghum was growing much faster in both periods. The slowing down and, sometimes, outright decline in yield trends call for more scientific investigation. But the development of high yielding variety of millet and sorghum will diminish the byproducts, (straw for fodder, thatching, fencing or fuel). Food crop research strategies should therefore seek to optimize both food and fodder production (World Bank, 1987).

Maize is also an important food crop in the Sahel but unlike millet and sorghum has high genetic capability. It can be produced at import parity price and has high fertilizer response. Thus, research on maize could be on the priority list. Its yield has also been growing much more slowly and has declined in some countries in the late 80s. But a lot of research results on maize currently remain "on the shelf". The absence of effective extension services required to transfer research results to farmers raises an additional issue. Should additional resources be spent on agricultural research or should the strengthening of extension services be given priority?

Consideration for research on food crops cannot ignore the **import substitution** question.

Declining ability to import has halted growth in food imports in recent years. In the early 80s, food imports grew annually by 46% in Burkina Faso, by 19% in Gambia, by 15% in Mauritania, by 21% in Niger, and declined by 0.2% in Senegal. Rice, wheat and maize account for the bulk of the food imports and represent a substantial drain on foreign exchange.

Due to low level of cropping intensity in most of these countries, irrigated rice may not be profitable especially with the current import parity price. In the Sahel like in most of SSA, the natural risks for farmers are already high, therefore crops with economic risks do not have a chance with farmers even with supportive technology. Consequently, the development of appropriate technology for growing these crops may be unwarranted. Yet, the demand for rice and wheat is highly income elastic and the two food items are consumed by important political constituents: the urban populace. From the political and import substitution point of view, research on rice will make sense (wheat cannot be produced in the Sahel), but on equity and economic efficiency criteria, it may be difficult to justify. Moreover, the likelihood of a scientific breakthrough in rice research is unlikely especially low land irrigated rice. Furthermore, this goes contrary to the argument that research priorities should be assigned to those commodities for which a country is either already an efficient producer or where the prospects for substantial technological advance can significantly improve efficiency (World Bank, 1987).

IV. THE SADCC REGION

Some of the discussions on the Sahel region in terms of the trade-offs may apply to the SADCC as well and will not be repeated here.

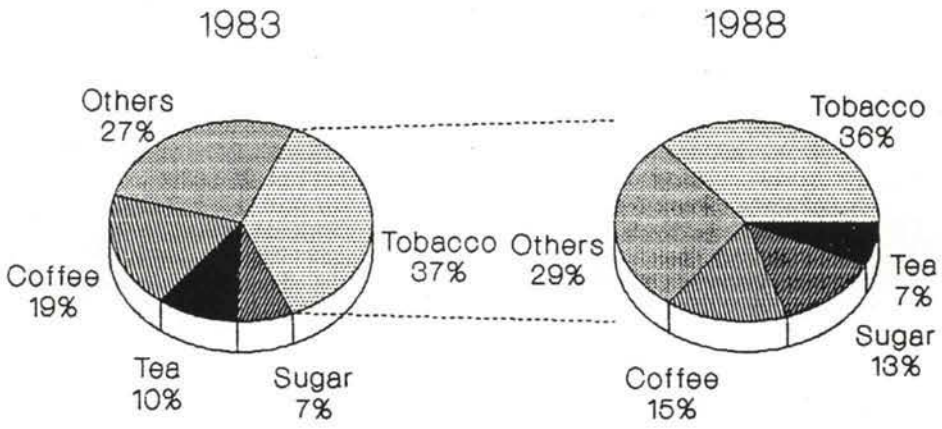
Export Crops

Tobacco, tea, coffee, and to a lesser extent, cotton are the main exports from this region (see Fig. 3). In 1988, tobacco accounted for 68% of total agricultural export in Malawi, 19% in Zambia, 49% in Zimbabwe and 7% in Tanzania. Cotton accounted for 27% of agricultural export in Tanzania, 18% in Zambia, and 15% in Zimbabwe. Coffee is very important in Tanzania (37%), so is tea in Malawi. Many of the countries of SADCC with the notable exception of Botswana are experiencing balance of payment difficulties. This situation makes it imperative for them to increase exports and reduce imports. Inappropriate domestic policies (especially in Zambia and Tanzania) and falling commodity prices have worsened the situation. While the former is within their control, the latter is completely exogenous. Tanzania lost world market shares in agricultural exports because of import substitution policies (the shift in the 70s from cotton and coffee into food, partly, as a result of food security concerns). The only way, therefore, to maximize export receipts is to reduce the cost of production, improve both yields and the domestic policy environment.

Reduction in cost of production and improvement in yield would require technical change and this is where agricultural research becomes critical. But on which commodities should scarce research resources be put on? In Tanzania, cotton production exceeds the country's capacity for ginning. This has hurt the export of cotton, and calls for the development of local and affordable ginning technology. In Zambia, as in other countries, important focus for cotton research will include: purification of presently grown varieties to improve uniformity of maturity, testing of promising varieties under different climatic conditions and focus on integrated pest management (Government of Zambia).

But the question remains; if cotton or tobacco technology is developed, how will it impact on the commercial, emergent, and smallholder farmers? For whom should the technology be developed? What of the implication for income distribution given variations in population densities? Moreover, except for Tanzania, cotton export was declining in most of the countries of this region. Cotton export was declining annually by about 3% in Botswana in the early 80s, and in the late 80s in Zambia and Zimbabwe. On the other hand, tobacco and coffee have fared relatively better. Export of tobacco,in the late 80s, was growing annually by 9% in Angola, 17% in Malawi, 12% in Tanzania and 7% in Zimbabwe while that of coffee was growing by 18% in Malawi, 13% in Tanzania, 34% in Zambia and 0.2% in Zimbabwe (see Table 6). Declining growth in export may be due to declining demand or lack of supply response. Any of these reasons will have different implications for research priorities.

Figure 3. Share of total agricultural export in the SADCC by major crops in 1983 and 1988.



Source: Data from FAO Trade Year Books

Agricultural research should have a well defined constituency with due consideration to pockets of population densities, growth regions and other equity concerns. In Zambia for instance, 80% of national production of cotton (1983 data) comes from the Southern and Central Provinces and only 13% from the Eastern Province. Agricultural research targeted to the estate farmers in Malawi helped to boost output of the sector but did not do much to help the income of smallholders. In fact, in instances where the new technology was labor saving, it would have reduced the income of subsistence farmers whose income is, often, partly from part time employment on the estate farms.

In Zimbabwe, the structure of agricultural production is such that commercial farmers account for all the exports. There are about 5,800 large-scale farmers on 15 million hectares; 8,500 small-scale commercial farmers on 1.5 million hectares and 840,000 farm families on 16 million hectares in the communal areas. In deciding research priorities, in Zimbabwe, it will be important to note that 50% of the total population and about 70% of rural population live in the communal area. Also, about 90% of the communal areas are located in the relatively low rainfall zones (lele and Stone, 1989).

This pattern of population density is not unique to Zimbabwe. About 60 percent of Tanzanian population live on 20 percent of the land, with higher population concentration on the areas of higher yielding crops (Lele and Stone, 1989). These areas known for intensive land use

Table 5. Commodity Shares in Total Agricultural Export in SADCC Countries (%).

A. Malawi

Commodities	1983	1985	1987	1988
Sugar	10.0	11.2	11.2	10.4
Coffee	6.3	--	3.6	3.5
Tea	20.5	--	10.8	11.3
Tobacco	54.2	47.2	66.1	67.6
Cereals	7.9	7.5	--	0.9
Fruits	3.7	2.1	4.6	1.2
Oil seed	1.6	1.9	2.5	3.5

B. Tanzania

Commodities	1983	1985	1987	1988
Sugar	1.3	1.3	2.0	2.2
Coffee	45.1	--	42.0	37.2
Tea	7.6	--	5.3	6.2
Fruits	5.0	6.7	10.4	8.7
Tobacco	5.1	5.8	6.0	7.2
Cotton	26.3	11.3	20.4	27.0

C. Zambia

Commodities	1983	1985	1987	1988
Sugar	3.3	15.5	32.1	29.4
Tobacco	40.0	17.1	4.1	18.8
Cotton	55.8	37.3	8.4	17.5
Oil seed	--	19.0	8.6	26.0

D. Zimbabwe

Commodities	1983	1985	1987	1988
Sugar	11.2	8.9	8.9	8.8
Cereal	9.9	5.7	10.0	5.6
Coffee	4.0	--	4.9	4.3
Tea	2.1	--	5.0	2.5
Tobacco	48.8	46.0	45.9	49.3
Cotton	16.1	19.4	13.2	15.4

Source: Computed from FAO Trade Year Books (1984 and 1988).

Table 6. Annual Average Real Growth Rates in Agricultural Exports in the SADCC (%).

A.	Angola	1971-75	1976-79	1980-85	
	COFFEE GREEN	-5.0	-7.0	-5.9	
	COTTON LINT	-0.1	-7.2	NA	
	SISAL	22.0	9.8	-26.7	
	TOBACCO LEAVES	34.1	-11.1	8.8	
B.	Botswana	1971-75	1976-79	1980-85	
	COTTON	5.8	NA	-2.9	
C.	Malawi	1971-75	1976-79	1980-85	1986-88
	SUGAR REFINED	-48.7	NA	76.5	NA
	COFFEE GREEN	17.4	66.0	36.5	18.0
	TEA	4.8	4.5	13.5	-17.5
	COTTON LINT	-13.4	14.9	NA	NA
	TOBACCO LEAVES	12.8	8.1	2.5	17.3
D.	Tanzania	1971-75	1976-79	1980-85	1986-88
	CASHEWNUT	-3.9	-12.1	131.9	11.1
	COFFEE	2.7	25.1	-1.0	12.7
	TEA	1.4	11.0	0.1	3.0
	COTTON	0.2	-2.5	41.8	NA
	SISAL	-1.6	-12.7	-19.9	-3.3
	TOBACCO	1.3	3.9	6.6	12.0
E.	Zambia	1971-75	1976-79	1980-85	1986-88
	SUGAR REFINED	-37.3	NA	-18.3	68.1
	COFFEE GREEN	NA	NA	NA	34.4
	COTTON LINT	NA	NA	102.8	-2.6
	TOBACCO LEAVES	-24.1	3.3	NA	NA
F.	Zimbabwe	1971-75	1976-79	1980-85	1986-88
	SUGAR REFINED	139.5	6.7	11.8	4.6
	COFFEE GREEN	46.2	21.8	23.1	0.2
	TEA	68.0	10.8	16.2	-10.4
	COTTON LINT	11.1	11.9	8.6	-2.5
	TOBACCO LEAVES	6.2	-8.7	21.1	7.0

Source: Computed from FAO data in the World Bank Data Base.

Table 7. Share of Harvested Area by Crops in the SADCC (%).

A.	Angola	1980	1985	1988
	WHEAT	0.96	0.38	0.19
	RICE	1.59	1.58	1.14
	MAIZE	47.82	47.54	56.84
	MILLET	6.38	5.94	6.32
	POTATOES	0.44	0.44	0.35
	CASSAVA	38.26	39.62	31.58
	SUGAR-CANE	1.20	1.19	0.95
	GROUNDNUT	3.19	3.17	2.53
	COCOA	0.17	0.14	0.11
B.	Botswana	1980	1985	1988
	WHEAT	0.1	0.2	0.1
	MAIZE	23.8	7.8	11.3
	MILLET	7.3	9.5	4.0
	SORGHUM	66.8	81.5	79.8
	GROUNDNUT	1.9	1.0	4.8
C.	Lesotho	1980	1985	1988
	WHEAT	14.0	15.5	11.4
	BARLEY	0.6	0.6	0.5
	MAIZE	53.4	50.3	58.4
	SORGHUM	29.7	32.2	27.0
	PEAS, DRY	2.3	1.5	2.7
D.	Malawi	1980	1985	1988
	WHEAT	0.03	0.06	0.14
	RICE	2.8	1.2	1.2
	MAIZE	63.6	65.5	66.5
	MILLET	0.8	1.0	1.1
	SORGHUM	2.0	1.9	1.7
	POTATOES	5.0	4.7	4.6
	CASSAVA	3.0	4.6	3.4
	SUGAR-CANE	0.9	0.8	0.8
	PEAS	4.5	4.2	4.2
	GROUNDNUT	16.4	14.9	15.4
	TEA	1.1	1.2	1.1

(continued)

Table 7. Continued.

E.	Mozambique	1980	1985	1988
	WHEAT	0.17	0.24	0.24
	RICE	4.2	4.2	4.2
	MAIZE	33.3	36.3	36.3
	MILLET	1.1	1.2	1.2
	SORGHUM	13.9	12.1	12.1
	POTATOES	0.3	0.4	0.4
	CASSAVA	33.3	34.5	35.1
	SUGAR-CANE	2.8	1.5	1.2
	GROUNDNUT	10.0	9.1	9.1
	TEA	1.1	0.5	0.2

F.	Swaziland	1980	1985	1988
	WHEAT	0.37	0.4	0.3
	RICE	1.74	0.4	0.3
	MAIZE	65.23	59.7	60.5
	SORGHUM	2.10	1.8	1.6
	POTATOES	2.75	2.8	2.4
	SUGAR	23.68	32.1	32.3
	PEAS	1.62	1.7	1.5
	GROUNDNUT	2.51	1.3	1.1

G.	Tanzania	1980	1985	1988
	WHEAT	1.6	1.0	1.2
	RICE	1.6	5.8	7.9
	BARLEY	0.1	0.1	0.1
	MAIZE	35.1	39.0	39.9
	MILLET	11.3	8.5	6.8
	SORGHUM	18.6	11.0	11.7
	POTATOES	0.8	0.8	0.8
	CASSAVA	11.3	16.3	15.9
	YAMS	0.0	0.0	0.0
	SUGAR	1.3	0.3	0.3
	PEAS	2.2	4.4	3.4
	CASHEWNUT	1.8	1.4	0.9
	SOYBEANS	0.1	0.1	0.1
	GROUNDNUT	2.3	2.4	2.3
	COCONUT	6.3	6.4	6.6
	COCOA	0.0	0.0	0.0
	TEA	0.5	0.2	0.4

(continued)

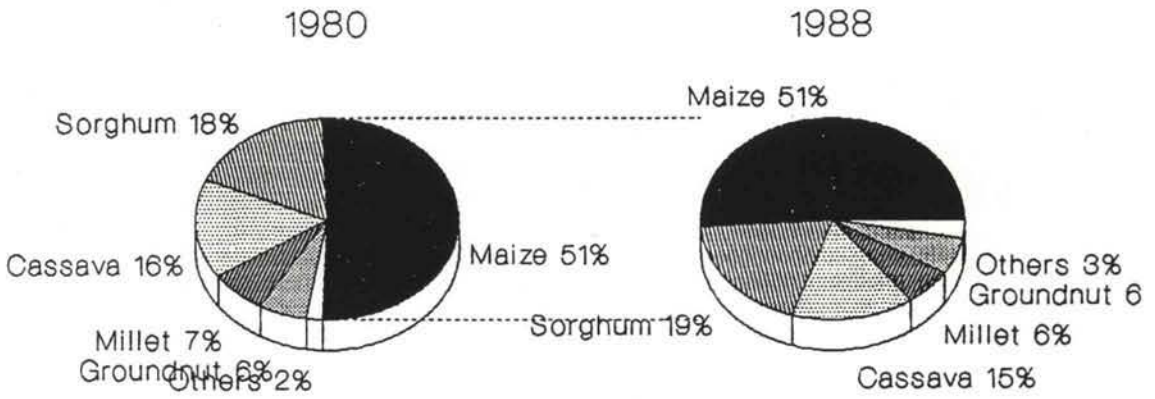
Table 7. Concluded.

H.	Zambia	1980	1985	1988
	WHEAT	0.3	0.7	0.7
	RICE	0.7	1.4	1.0
	BARLEY	0.4	0.3	0.3
	MAIZE	78.3	76.4	72.6
	MILLET	2.8	3.0	4.4
	SORGHUM	4.2	3.3	4.8
	POTATOES	0.0	0.0	0.0
	CASSAVA	7.7	8.6	7.1
	SUGAR-CANE	1.3	1.3	1.0
	SOYBEANS	0.5	1.3	2.0
	GROUNDNUT	3.6	3.4	6.0
	TEA	0.0	0.1	0.0
I.	Zimbabwe	1980	1985	1988
	WHEAT	2.0	1.9	2.0
	RICE	0.03	0.0	0.0
	BARLEY	0.2	0.2	0.2
	MAIZE	58.2	62.3	57.4
	MILLET	19.6	12.4	16.5
	SORGHUM	6.5	11.6	9.7
	POTATOES	0.1	0.1	0.1
	CASSAVA	1.0	1.0	1.0
	SUGAR-CANE	1.3	1.6	1.4
	SOYBEANS	2.6	2.1	2.3
	GROUNDNUT	8.3	6.6	9.3
	TEA	0.2	0.2	0.2

Source: Computed from FAO Data in the World Bank Data Bank.

will require supportive technology if production is not to be shifted to marginal lands with serious consequences for soil degradation and the environment. But yield potentials in tobacco, groundnut and maize are higher in the low-densely populated, central region of Malawi, contrary to the Boserup hypothesis (Lele and Stone, 1989). These facts suggest that research priorities must be tailored to individual country circumstances to recognize differences in population densities and the potential for agricultural intensification. In the case of Zimbabwe, agricultural research targeted to the communal areas will assist in spreading development and redistribution of income. Adapting existing research results to the needs of communal farmers will be an important first step. But due to location specificity of the agro-socioeconomic conditions of small farmers, and the small scale nature of their production, it is a much greater challenge to develop technology which they will be motivated to accept than it is to develop technology for commercial farmers. Besides, focusing research on communal farmers may delay growth.

Figure 4. Share of harvested area in the SADCC by major crops in 1980 and 1988.



Source: FAO Data from the World Bank

In the SADCC, tobacco and cotton are common across countries. Should research on these crops be on the priority agenda and can it be regionalised? The question is ominous given that regional efforts, especially in the case of cotton, appear to have paid off in the SAHEL. For cotton, there is also the question of declining growth in export. However, it should also be noted that in Africa, in general, men exercise, some what of, an exclusive right over the production of cash crops. What will be the implications of spending scarce research resources on these crops given the increasing recognition of the role of women in agriculture and development in general ? These and other concerns should influence research priorities.

Food Crops

The major food crops in SADCC are maize, millet, cassava and sorghum (see Fig. 4 for their respective shares of harvested area in the region). Individual country pictures are as reported in Table 7. In 1988, maize accounted for 57% of all harvested area in Angola, 11% in Botswana, 58% in Lesotho, 65% in Malawi, 36% in Mozambique, 60% in Swaziland, 40% in Tanzania, 72% in Zambia and 57% in Zimbabwe. Average annual growth in yields in the late 80s have been very low for several countries and were even declining in some. For Lesotho, Malawi, and Mozambique, yield growth rate averaged less than 1%. For Tanzania, Zambia and Zimbabwe, it averaged 8% but was declining by 8% in Angola.

Table 8. Annual Average Growth Rates in Crop Yields in the SADCC (%).

A.	Angola	1981-85	1986-89	1981-89
	WHEAT	1.4	7	3.9
	RICE-PADDY	2.0	-2.2	0.1
	MAIZE	-6.0	-8.3	-7.0
	MILLET	-1.1	-1.3	-1.2
	POTATOES	0.0	-3.1	-1.4
	CASSAVA	0.2	-0.4	0.0
	SUGAR-CANE	-1.3	5.4	1.7
	GROUNDNUT (IN SHELL)	0.0	0.0	0.0
	COCOA-BEANS	-8.3	0.0	-4.6
B.	Botswana	1981-85	1986-89	1981-89
	WHEAT	13.3	0.0	7.4
	MAIZE	5.7	30.7	16.8
	MILLET	16.2	50.8	31.6
	SORGHUM	4.8	37.4	19.3
	GROUNDNUT (IN SHELL)	68.3	-31.3	24.0
C.	Lesotho	1981-85	1986-89	1981-89
	WHEAT	-11.2	5.9	-3.2
	BARLEY	5.0	0.8	3.1
	MAIZE	-3.4	0.7	-1.3
	SORGHUM	-3.4	3.2	2.5
	PEAS, DRY	-7.5	3.1	-3.1
D.	Malawi	1981-85	1986-89	1981-89
	WHEAT	9.6	0.3	5.5
	RICE PADDY	5.1	2.8	4.1
	MAIZE	-0.6	0.5	-0.1
	MILLET	43.4	1.8	24.9
	SORGHUM	13.6	2.2	8.5
	POTATOES	0.5	1.7	1.0
	CASSAVA	-9.7	-4.3	-7.3
	SUGAR-CANE	0.7	0.3	0.5
	PEAS-COWDRY	0.9	2.7	1.7
	GROUNDNUT (IN SHELL)	-0.4	-0.2	-0.3

(continued)

Table 8. Continued.

E.	Mozambique	1981-85	1986-89	1981-89
	WHEAT	9.4	6.7	8.2
	RICE-PADDY	-3.3	0.2	-1.7
	MAIZE	-2.1	0.4	-1.0
	MILLET	0.0	0.0	0.0
	SORGHUM	2.7	-0.4	1.3
	POTATOES	-1.5	0.3	-0.7
	CASSAVA	2.3	0.7	1.6
	SUGAR-CANE	-19.7	3.5	-9.4
	GROUNDNUT (IN SHELL)	-3.7	4.0	-0.3
	TEA	-4.2	-10.2	-6.9
F.	Swaziland	1981-85	1986-89	1981-89
	WHEAT	0.0	0.0	0.0
	RICE-PADDY	33.8	0.0	18.8
	MAIZE	18.1	6.8	13.0
	SORGHUM	24.3	1.7	14.2
	POTATOES	1.7	9.6	5.2
	SUGAR-CANE	-2.0	0.8	-0.7
	PEAS-COWDRY	0.1	0.0	0.1
	GROUNDNUT (IN SHELL)	13.2	0.0	7.3
G.	Tanzania	1981-85	1986-89	1981-89
	WHEAT	16.6	-5.5	6.8
	RICE-PADDY	4.9	8.7	6.6
	BARLEY	1.6	-0.5	0.7
	MAIZE	6.8	3.9	5.5
	MILLET	1.8	3.8	2.7
	SORGHUM	5.3	3.8	4.6
	POTATOES	0.3	1.0	0.6
	CASSAVA	0.7	-8.6	-3.4
	YAMS	-2.2	1.8	-0.4
	SUGAR-CANE	46.9	1.8	26.9
	PEAS, DRY	2.5	-2.2	0.4
	PEAS-COWDRY	2.2	-1.4	0.6
	CASHENUT	8.2	1.4	5.2
	SOYBEANS	13.9	4.1	9.5
	GROUNDNUT (IN SHELL)	0.5	-1.6	-0.4
	COCONUT	-0.1	-0.6	-0.4
	PALMKERN	0.4	1.8	1.0
	COCOA-BEANS	8.4	8.5	8.4
	TEA	19.7	-12.0	5.6

(continued)

Table 8. Concluded.

H.	Zambia	1981-85	1986-89	1981-89
	WHEAT	-2.6	11.6	3.7
	RICE-PADDY	24.8	0.0	13.8
	BARLEY	NA	0.0	NA
	MAIZE	4.2	7.2	5.5
	MILLET	-1.2	-4.9	-2.9
	SORGHUM	11.1	3.3	7.7
	POTATOES	1.5	1.5	1.5
	CASSAVA	0.1	2.2	1.0
	SUGAR-CANE	5.1	3.0	4.2
	SOYBEANS	26.8	-8.0	11.3
	GROUNDNUT (IN SHELL)	-0.8	-4.4	-2.4
	TEA	3.1	1.0	2.2

I.	Zimbabwe	1981-85	1986-89	1981-89
	WHEAT	1.7	0.5	1.2
	RICE-PADDY	61.9	29.6	47.5
	BARLEY	3.2	0.3	2.0
	MAIZE	35.0	10.1	23.9
	MILLET	18.8	14.2	16.8
	SORGHUM	28.3	33.3	30.5
	POTATOES	1.4	-0.1	0.7
	CASSAVA	5.7	-1.4	2.5
	SUGAR-CANE	1.6	2.4	1.9
	SOYBEANS	1.8	15.4	7.8
	GROUNDNUT (IN SHELL)	27.5	3.8	17.0
	TEA	9.8	3.4	6.9

Source: Computed from FAO Data in the World Bank Data Base

What accounts for this differences in yield performance? Is it simply technology or are there other factors such as war in Angola and Mozambique and refugee problems in Malawi? A lot of research has been done on maize especially in developing high yielding varieties. But farmers in Malawi have been resistant in adopting these high yielding varieties despite about 20 years of extension work. There are a number of reasons for this. First, the high yielding varieties do not have the same taste as the local variety. Second, the local variety is more resistant to insects and stores better. Third, processing (peeling of husks, pounding etc.) time of high yielding varieties into food is higher than that for local variety. These concerns clearly demonstrate the need for socio-economic work to precede and guide research. For maize, there

Table 9. Annual Average Real Growth Rates in Imports of Agricultural Products (SADCC) (%).

A.	Angola	1971-79	1980-85	1986-88
	CEREALS-TOT	28.1	-9.1	16.0
	RICE-TOT	88.2	-6.8	31.8
	WHEAT	19.0	-7.4	227.4
	POTATOES	NA	-15.8	-11.9
	BEANS-DRY	361.3	6.7	49.8
	TOTTRADE-MERCHAND	5.6	8.8	-0.5
	TOTAGR-PRODUCT	16.1	3.3	0.4
	FOOD-ANIMALS	21.2	2.5	1.0
	TOTAGR-FISHETC	15.4	6.7	-4.8
B.	Botswana	1971-79	1980-85	1986-88
	TOTSUGAR-RAWEQ	7.7	12.5	1.0
	CEREALS-TOT	8.1	17.7	-7.1
	RICE-TOT	NA	20.3	2.9
	TOBACCO-PRODNES	NA	NA	3.8
	WHEAT	NA	NA	37.2
	MAIZE	28.5	23.7	-8.9
	SORGHUM	93.2	173.0	-4.7
	POTATOES	20.7	9.1	4.9
	TEA	6.9	-2.3	0.4
	TOTTRADE-MERCHAND	18.3	7.7	7.8
	TOTAGR-PRODUCT	8.4	9.5	2.2
	FOOD-ANIMALS	10.6	8.7	0.6
	TOTAGR-FISHETC	8.4	10.5	1.5
C.	Lesotho	1971-79	1980-85	1986-88
	TOTSUGAR-RAWEQ	16.1	9.4	-3.1
	COFFEE-GRNROAST	NA	13.0	29.3
	CEREALS-TOT	24.0	9.5	-3.8
	RICE-TOT	NA	14.1	7.6
	TOBACCO-PRODNES	NA	8.3	1.2
	WHEAT	NA	16.6	-1.2
	MAIZE	NA	20.4	8.0
	SORGHUM	18.0	494.4	1.2
	BEANS-DRY	NA	112.9	1.2
	TEA	NA	21.2	-2.5
	TOTTRADE-MERCHAND	21.7	2.6	18.9
	TOTAGR-PRODUCT	21.4	6.8	-0.4
	FOOD-ANIMALS	17.0	7.4	-0.6
	TOTAGR-FISHETC	21.6	7.8	-0.3

(continued)

Table 9. Continued.

D.	Malawi	1971-79	1980-85	1986-88
	COTTON-OIL	NA	NA	NA
	TOTSUGAR-RAWEQ	93.8	NA	NA
	COFFEE-GRNROAST	11.4	-1.7	NA
	CEREALS-TOT	-10.1	40.3	71.3
	RICE-TOT	164.1	93.8	372.2
	TOBACCO-PRODNES	9.8	NA	NA
	WHEAT	NA	171.6	16.5
	MAIZE	NA	NA	NA
	SORGHUM	304.0	NA	NA
	TEA	17.2	207.4	NA
	TOTTRADE-MERCHAND	7.9	-3.7	9.6
	TOTAGR-PRODUCT	-3.8	-0.1	3.9
	FOOD-ANIMALS	-3.4	-0.7	19.0
	TOTAGR-FISHETC	-2.1	1.3	0.8
E.	Tanzania	1971-79	1980-85	1986-88
	TOTSUGAR-RAWEQ	NA	47.8	-0.5
	CEREALS-TOT	167.7	85.7	-18.4
	RICE-TOT	212.0	69.0	4.6
	WHEAT	NA	15.5	7.9
	MAIZE	202.9	NA	NA
	PALM-OIL	29.7	116.1	124.9
	TEA	88.7	NA	NA
	TOTTRADE-MERCHAND	6.6	3.5	2.5
	TOTAGR-PRODUCT	8.5	20.6	-5.9
	FOOD-ANIMALS	12.6	33.8	-14.9
	TOTAGR-FISHETC	6.3	16.1	-5.6
F.	Zambia	1971-79	1980-85	1986-88
	COTTON-OIL	40.4	90.2	NA
	TOTSUGAR-RAWEQ	9.1	-35.2	NA
	COFFEE-GRNROAST	0.9	6.6	180.7
	PALMKERN-OIL	22.8	NA	59.2
	CEREALS-TOT	11.0	43.1	45.2
	RICE-TOT	10.8	24.8	7.5
	WHEAT	10.7	23.6	14.3
	TEA	-3.6	3.5	7.7
	TOTTRADE-MERCHAND	1.4	8.9	2.3
	TOTAGR-PRODUCT	1.9	8.7	17.0
	FOOD-ANIMALS	1.5	6.6	23.4
	TOTAGR-FISHETC	4.3	8.0	15.3

(continued)

Table 9. Concluded.

G.	Zimbabwe	1971-79	1980-85	1986-88
	MILLET	60.5	NA	-34.6
	COFFEE	-16.6	54.9	NA
	CEREALS	-5.9	12.0	7.0
	RICE	15.0	12.7	44.4
	WHEAT	-9.3	28.7	NA
	BEANS-DRY	11.0	-12.0	111.2
	TOTTRADE-MERCHAND	-6.0	15.6	3.4
	TOTAL AGRIC	-6.2	20.3	-3.3
	FOOD	-6.5	17.4	-14.7
	TOTAL AGR + FISH	9.0	24.2	-2.9

Source: Computed from FAO data in the World Bank Data Base.

is an urgent need to improve the acceptability of the high yielding variety since this is the principal food item in this region.

Sorghum and millet are important food crops in the SADCC. In 1988, sorghum accounted for 80% of all harvested area in Botswana, 27% in Lesotho, 12% in Mozambique, 12% in Tanzania, 10% in Zimbabwe, 5% in Zambia and 2% in Malawi. Millet accounted for 6% of all harvested area in Angola, 4% in Botswana, 7% in Tanzania, 4% in Zambia and 16% in Zimbabwe (see Table 7).

Sorghum and millet are important food crops in the SADCC. In 1988, sorghum accounted for 80% of all harvested area in Botswana, 27% in Lesotho, 12% in Mozambique, 12% in Tanzania, 10% in Zimbabwe, 5% in Zambia and 2% in Malawi. Millet accounted for 6% of all harvested area in Angola, 4% in Botswana, 7% in Tanzania, 4% in Zambia and 16% in Zimbabwe (see Table 7). Research on sorghum and millet has not received the same attention as maize and so researchers have limited experience with their potential and production practices. The quantity of sorghum traded is relatively small but it is widely consumed. It represents the main staple food for many subsistence farm families and provide cash income from beer making. Should the research focus be on sorghum as food or as an input into beer making or both ? Unlike maize, sorghum and millet adapt to hot and dry conditions, as well as heavy and waterlogged soils. Furthermore, both sorghum and millet can be intercropped with groundnuts, cowpeas, okra and sometimes maize.

In spite of these, yield performance has been mixed. Average growth rate in sorghum yield in the late 80s was 3% in Lesotho, 2% in Malawi, -0.4% in Mozambique, 2% in Swaziland, 4% in Tanzania, 3% in Zambia and 33% in Zimbabwe. Yields in millet declined by 1% in Angola, 5% in Zambia but grew by 2% in Malawi, 4% in Tanzania, 14% in Zimbabwe and did not grow in Mozambique (see Table 8). Given these conditions, improvement in yields should be on the research priority agenda. In particular, the identification

of biological constraints limiting the production of millet and sorghum and the development of improved variety should form part of the focus of this research. The limiting factors here are the limited market potential for these crops and the low nutritional value.

Rice and wheat are important food crops which are not produced in any significant quantity in the SADCC region (except in Zimbabwe: see Morris, 1989) but whose consumption has been rising. For instance, wheat production accounted for less than one percent of total harvested area in the SADCC countries except Tanzania (1.2%) and Zimbabwe (2%). However, in the late 80s (see Table 9), real average annual growth rates of imports of wheat was 227% in Angola, 37% in Botswana, 17% in Malawi, 8% in Tanzania, 14% in Zambia, and in the early 80s, 28% in Zimbabwe. At the same period, rice imports was growing annually by 32% in Angola, 3% in Botswana, 8% in Lesotho, 372% in Malawi, 5% in Tanzania, 8% in Zambia and 44% in Zimbabwe. From the foreign exchange perspective, research in rice and wheat production makes sense. However, it is doubtful that these crops can be produced at import parity price.

V. PESSIMISM AND THE NEED FOR A "BIG BANG"

The current pessimistic outlook in sub-Saharan Africa is a great danger, even much worse than the excessive optimism of the early post independence years (Obidegwu, 1990). This outlook leads to inertia, lack of initiative, and resignation to fate (since nothing works); it does not allow learning from previous accomplishments; it leads to policy instability and economic uncertainty. Consequently, there is a compelling reason, at least in the short-term, to focus research on crops or systems that promise quick production responses, even if this results in a degree of neglect elsewhere and that equity considerations are not met. The primary objective of this will be to break the pessimistic mood, restore hope and demonstrate that it is possible for agricultural production in SSA to grow faster than population.

VI. AGENDA FOR FUTURE RESEARCH

This paper's main contribution is in identifying a set of criteria and the sort of trade-offs involved in setting agricultural research priorities in SSA. Its main weakness is in not using the methods identified in section II to derive appropriate weights for the most critical criteria. Therefore, future research should focus on how to derive these weights so that an optimal mix of weighted criteria for allocating research resources, which balances growth with equity, can be attained. As more and more of SSA economies are becoming market driven, the hypothesis that in a market economy, scarce research resources are usually allocated to develop new technology that saves the increasingly scarce factors of production or to technology that can be applied to commodities that have larger market demand needs to be investigated. The relevance of this hypothesis even for a non market economy like China has been demonstrated (see Lin, 1991).

VII. SUMMARY AND CONCLUSIONS

As agricultural productivity declines, resources dwindle and donor-fatigue sets in, the question of research priorities looms even larger. This paper has demonstrated that setting agricultural research priorities in SSA will require a well defined set of criteria the choice of which depends on the national goals. But of equal importance is the understanding that this choice involves

important trade-offs. For sustainable development, research resources must be spent on commodities that balance growth with equity. But it may be necessary, especially in the short run, to focus research on crops that have quick production responses in order to break the current pessimistic mood and restore hope.

Regional coordination of research efforts is essential, and must be encouraged, where common research interests among nations are identified. Donors and international development institutions should have a coordinated effort in assisting agricultural research in SSA but the research agenda must be demand driven.

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